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(54) A CROSSHEAD ARRANGEMENT FOR THE DRIVE MECHANISM OF HIGH-PRESSURE COMPRESSORS AND PUMPS

(71) We, MACHINENFABRIK BURCKHART A.G. of Dornacherstrasse 192, Basle, Switzerland, a Swiss Corporation, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a crosshead arrangement for the drive mechanism of high-pressure compressor machines such as compressors and pumps having opposed cylinders.

In such machines only one crank mechanism with a main crosshead is provided for the or each pair of cylinders, the piston of one cylinder being connected to the main crosshead and that of the opposite cylinder to a cross-member constructed as a secondary crosshead and connected to the main crosshead by a by pass linkage. With this arrangement the drive is acted upon not by the sum but by the difference of the working piston forces in the or each pair of cylinders, which permits of optimum utilisation of the construction.

Crosshead arrangements equipped with a bypass linkage are known for this purpose wherein for the unhindered fitting and removing of the connecting rod, which is carried out through the upper frame aperture associated with the particular cylinder axis, the cylindrical crosshead pins with conical fixing ends, clamped in the main crosshead with or without clamping sleeves, are to be fitted and demounted from the side through the closable assembly apertures arranged laterally of the drive frame, without the crosshead and the cross-member constructed as a secondary crosshead having to be taken out in the process.

In actual practice this has resulted in limiting the construction to two cranks in a row. In the case of three or more cranks in a row the fitting and demounting of the crosshead pin member and the connecting rod without removing the main crosshead would be possible only at the two outer crank parts whereas at the crank parts situated in between the main crosshead would have to be demounted, which involves difficult and time-consuming work.

Crosshead arrangements in frame form are also known which permit fitting and demounting of the connecting rod and the crosshead pin in the case of drives having more than two cranks in a row also.

These known crosshead arrangements each comprise an upper and a lower connecting member held together with screws, connecting the main and secondary crossheads and comprehending the circular path of the crank pin, the said member being subjected to the action of piston forces occurring during reciprocating movement. Between the joints of the upper and lower connecting members there is securely fixed at one side of the crosshead frame in a housing bore, divided by the joints into two halves, the crosshead pin which is adapted to be clamped e.g. with clamping sleeves and, separately therefrom, at the end, an intermediate member containing the piston rod or plunger coupling with plate-shaped crosshead shoes arranged on the centre axis at both sides, serving as the main crosshead shoes, by means of bolts which hold the upper and lower connecting members together and are arranged at both sides of the crosshead pin in a horizontal plane.

On the opposite side of the crosshead frame the second intermediate member is fixed, which also contains the piston rod or plunger coupling and has fixedly arranged plate-form crosshead shoes at both sides serving as secondary crosshead shoes.

With this arrangement, the entire width of the two effective crosshead guideways is given by the total length of the fixedly held crosshead pin and the width of the

plate-form crosshead shoes extending laterally at the two end faces. This arrangement is a contributory factor in determining the spacing of the cylinder axes in the drive frame.

For demounting the connecting rod, after the removal of the nuts from the bolts holding the upper and lower connecting members together, the upper connecting member can be pulled through the upper frame aperture, thus giving an unhindered possibility of demounting the crosshead pin and connecting rod irrespective of the number of cranks in the drive frame. For the size and number of the bolts required at the side of the main crosshead for connecting the upper and lower connecting members, the determining factor is the radial force which is produced at the clamping of the crosshead pin end and acts within the housing bore divided into two halves, and the moment of force produced in the operation of the machine, determined by the maximum working piston force acting in the struts and a lever arm defined by the distance of the strut from the centre axis, taking into account the alternating stresses occurring at the time.

The dimensions of the bolts obtaining more particularly with high piston forces for reliably preventing spreading-out at the fixing points, and the number of such bolts result in heavy and involved constructions which, with the oscillatory movement of the crosshead frame, increase the inertia effect. With these known crosshead frames, the connecting rod bearing at the crosshead side is also pivotably connected in a closed construction axially to the cylindrical crosshead pin, and re-adjustability is not possible in this case owing to the close construction of the connecting rod head, nor it is possible to carry out an inspection of the crosshead pin and the crosshead pin bearing without dismantling the crosshead frame.

A crosshead arrangement according to the invention comprises: a lower part provided with main and secondary sliding shoes serving to accept force normal to the direction of movement of the crosshead; an upper part releasably connected to the said lower part; and a crosshead pin member constructed as a middle part and arranged between the said lower and upper parts in the region of the main crosshead shoe, the said member being connected releasably to the piston rod of the first cylinder.

In order that the invention may be more thoroughly understood the drive mechanism of a machine having a crosshead arrangement in accordance with it will be described in some detail, by way of example, with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatic view of the crosshead frame arranged in a drive frame; and

Figure 2 shows the crosshead pin member with a block-form middle part.

Figure 1 shows a frame-form crosshead arrangement according to the invention which comprises an upper connecting part 1 and a lower connecting part 2, with a sliding shoe 3 which serves as a main crosshead guide and is arranged, either fixedly as shown or releasably, on the lower connecting part 2, and a sliding shoe 4 which serves as a secondary crosshead guide and is arranged at the opposite side.

At the side of the main crosshead shoe 3 there is inserted between the upper and lower connecting parts 1 and 2, the crosshead pin 5 having a block-form middle part 6, and guide studs or pins 7 fixed at both sides for pivotal connection to the forked connecting rod 16. The piston rod or plunger 13 is secured axially to the end face of the block-form middle part 6 by means of the releasable coupling 14.

In the region of the secondary crosshead shoe 4, a plain block-form part 8 (i.e. one which does not have laterally arranged guide pins) is inserted, and to its end face the second piston rod or plunger 13', situated opposite from the main side of the crosshead, is likewise releasably secured axially by means of a second coupling 14'.

Arranging a block-form middle part 8 at the same height as the block-form middle part 6 of the crosshead pin member 5 affords the advantage from the manufacturing point of view that the bearing surfaces of the upper connecting member 1 and lower connecting member 2 can be machined in a single plane.

At the secondary side of the crosshead, the block-form middle part 8 can be constructed with a different height from the block-form middle part 6 of the crosshead pin member 5 or the middle part 8 can be omitted entirely. In the latter case, the upper connecting member 1 can be directly connected centrally or eccentrically of the crosshead frame to the lower connecting member 2, with appropriate formation of the connecting members.

The entire crosshead frame is held together by vertically arranged fixing bolts 10 and nuts 11, or by appropriate headed screws, and force-transmitting element 9, 9' of adequate dimensions for receiving compression forces acting in the connecting struts, e.g. in the form of locating pins or keys, or disc-shaped fitting parts, are inserted between the joints of the connecting members 1 and 2 and the block-form middle parts 6 and 8 respectively. The elements 9 also serve for adjustment so that

the relative positions of the crosshead frame parts may be precisely determined at the assembly stage. The circular part of the crank pin 18 is disposed between the two connecting struts 12.

When forked connecting rods 16 are fitted, the connecting struts are formed with an aperture 15 on the centre axis for the passage of the crank-side bearing block and bearing cap 17. The aperture may be omitted when identical connecting rods articulated to the two crosshead pins 7 are fitted, in which case the struts 12 extend between the connecting rod bearing blocks and bearing caps in the crank region.

It is possible to dismantle this arrangement in a very simple manner, as follows: after the removal of the nuts 11 or the corresponding headed screws and the release of the rod coupling 14 at the crosshead side, the upper connecting part 1 and thus the connecting rod together with the crosshead member 5 can be pulled upwards out of the drive frame through the frame aperture 23 which is adapted to be closed with a cover 24, irrespective of how many cranks are arranged in a row in the drive frame. The lower connecting part 2 with the crosshead shoes 3 and 4 arranged thereon remains fitted in the crosshead guides 22.

A particular advantage with this arrangement of the crosshead frame is obtained by the construction of the crosshead pin member 5. With known constructions, the crosshead bearing in a closed construction is articulated axially to the through cylindrical crosshead pin, which is fixedly held in cylindrical bores of the side walls of the crosshead body or the connecting elements.

As compared with this construction, the crosshead pin member 5 has the advantage that under the action of forces its increased ridigity causes substantially reduced bending effects at the pins 7, which reduces the unilateral edge pressures in the mounting regions and in the crosshead pin bearings.

Since the connection for the releasable piston rod or plunger coupling is arranged at the block-form middle part 6 of the crosshead pin member 5 in addition to the two crosshead pins 7, and thus crosshead pin member and piston rod coupling block can be regarded as a single unit, the clamping forces caused by the clamping connection with the cylindrical crosshead pins do not occur.

Owing to the omission of the cylindrical housing bore and the bolts necessary for clamping the crosshead pin, the frame-form crosshead arrangement can use substantially simplified constructional elements of which good use is made, as regards force transmission.

The dimensions of the vertically arranged fixing bolts 10 which serve for clamping the crosshead pin member 5 between the upper and lower connecting members 1 and 2 are in accordance with the moment of force resulting from the forces acting in the struts 12 and the spacing a between the upper edges of the block 6 and the struts 12.

The alternating stresses in the long-fixing bolts 10, which occur at the reciprocating movement of the cross-head frame and are caused by the particular force action in each case can be kept to a value which is not dangerous to operation by the use of a preloading force causing longitudinal extension in the shank.

An important advantage of the crosshead arrangement according to the invention is that with the frame-form construction the entire width of the crosshead shoes 3 and 4 can be fully utilised as a load-bearing width for sliding on the slideways, independently of the crosshead pin length. As a result a construction is obtained which makes it possible to reduce the spacings of the cylinder axes in the drive to only what is necessary for the cylinder dimensions, which gives substantial shortening of the overall length in the direction of the crankshaft axis and a substantial reduction in the moments of inertia as compared with known constructions.

WHAT WE CLAIM IS:—

1. A high-pressure compressor or pump having first and second opposed cylinders and, in the drive mechanism, a crosshead arrangement for driving the piston rods of the first and second cylinders, and comprising; a lower part with main and secondary sliding crosshead shoes serving to accept force normal to the direction of movement of the crosshead; an upper part releasably connected to the said lower part; and a crosshead pin member constructed as a middle part, and arranged between the said lower and upper parts in the region of the main crosshead shoe, said member being connected releasably to the piston rod of the first cylinder.

2. A machine according to claim 1, in which a second, plain, middle part is arranged between the said lower and upper parts in the region of the secondary crosshead shoe, and is connected releasably to the piston rod of the second cylinder.

3. A machine according to claim 1, in which the said upper part and the said lower part are directly connected to one another in the region of the seconday crosshead shoe.

4. A machine according to claim 1, having horizontal cylinders, in which the assembly of the said upper connecting part and the said lower connecting part with the said middle part in the region of the

main crosshead shoe, and in the region of the secondary crosshead shoe is effected at both sides of the crosshead frame with vertical screw-threaded members adapted to be released from above.

5. A machine according to claim 2, in which force-transmitting elements which also serve for adjustment purposes, are interposed between the said middle parts and the said upper connecting member and the said lower connecting member respectively.

6. A machine according to claim 3, in which force-transmissing elements, which also serve for adjustment purposes, are interposed between the said middle part and the said upper connecting member and the said lower connecting member respectively in the region of the main crosshead shoe and between the upper connecting member and the lower connecting member in the region of the secondary crosshead shoe.

7. A high-pressure compressor or pump having a cross-head arrangement substantially as described with reference to Figure 1 and Figure 2 of the accompanying drawing.

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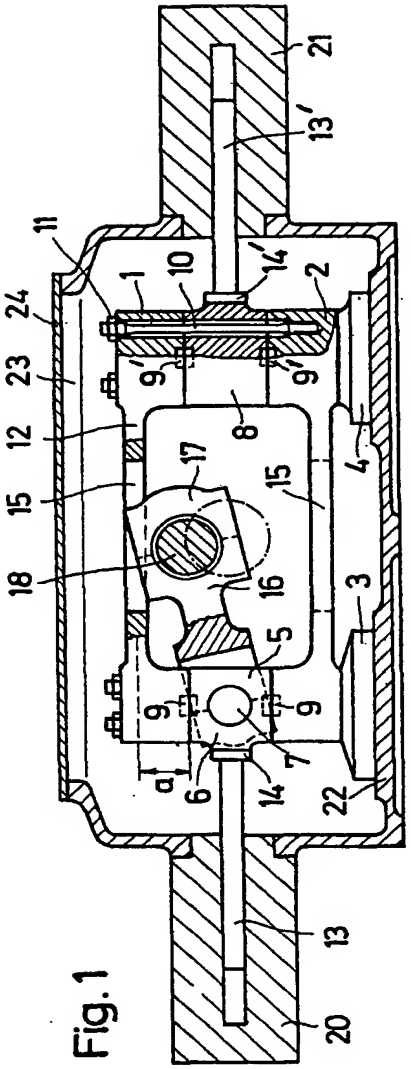

Fig.1

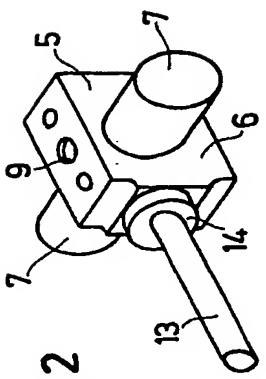

Fig.2